

APPENDIX III.

Serial No.: 09/520,032

Docket No.: 49933US031

Supplemental Preliminary Amendment filed May 4, 2001.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s):	Timothy L. HOOPMAN et al.)	Group Art Unit:	3726
Serial No.:	09/520,032	Examiner:	J. Leyson
Filed:	6 March 2000		
For:	TOOLS TO MANUFACTURE ABRASIVE ARTICLES		

SUPPLEMENTAL PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Prior to the examination of the above-identified patent application, please enter the following amendments:

In the Claims

Please add new claims 88-132 and amend previously submitted claims 23, 24, 56, and 57. The new claims are provided below in clean form. Per 37 C.F.R. § 1.121, amended claims are also shown in Appendix A with notations to indicate changes made (for convenience, all pending claims, including those added hereby, are provided in Appendix A).

23. (AMENDED) A production tool suitable for use in manufacturing an abrasive article comprising a first, second, and third plurality of cavities, wherein the first plurality of cavities each have a first geometric shape and first plurality of angles forming the geometric shape, the second plurality of cavities each have a second geometric shape and second plurality of angles forming the geometric shape, and the third plurality of cavities each have a third geometric shape and third

plurality of angles forming the geometric shape, wherein at least one of the angles of the first plurality is different from all of the angles of the second and third plurality of angles, and wherein at least one of the angles of the second plurality is different from all of the angles of the first and third plurality of angles.

24. (AMENDED) A production tool suitable for use in manufacturing an abrasive article comprising a first, second, third, and fourth plurality of cavities, wherein the first plurality of cavities each have a first geometric shape and first plurality of angles forming the geometric shape, the second plurality of cavities each have a second geometric shape and second plurality of angles forming the geometric shape, the third plurality of cavities each have a third geometric shape and third plurality of angles forming the geometric shape, and the fourth plurality of cavities each have a fourth geometric shape and fourth plurality of angles forming the geometric shape, wherein at least one of the angles of the first plurality is different from all of the angles of the second, third, and fourth plurality of angles, wherein at least one of the angles of the second plurality is different from all of the angles of the first, third, and fourth plurality of angles, and wherein at least one of the angles of the third plurality is different from all of the angles of the first, second, and fourth plurality of angles.

56. (AMENDED) A method of making a production tool, the method comprising:
creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a first, second, and third plurality of cavities, wherein the first plurality of cavities each have a first geometric shape and first plurality of angles forming the geometric shape, the second plurality of cavities each have a second geometric shape and second plurality of angles forming the geometric shape, and the third plurality of cavities each have a third geometric shape and third plurality of angles forming the geometric shape, wherein at least one of the angles of the first plurality is different from all of the angles of the second and third plurality of angles, and wherein at

least one of the angles of the second plurality is different from all of the angles of the first and third plurality of angles; and

forming the production tool using the design.

57. (AMENDED) A method of making a production tool, the method comprising:
creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a first, second, third, and fourth plurality of cavities, wherein the first plurality of cavities each have a first geometric shape and first plurality of angles forming the geometric shape, the second plurality of cavities each have a second geometric shape and second plurality of angles forming the geometric shape, the third plurality of cavities each have a third geometric shape and third plurality of angles forming the geometric shape, and the fourth plurality of cavities each have a fourth geometric shape and fourth plurality of angles forming the geometric shape, wherein at least one of the angles of the first plurality is different from all of the angles of the second, third, and fourth plurality of angles, wherein at least one of the angles of the second plurality is different from all of the angles of the first, third, and fourth plurality of angles, and wherein at least one of the angles of the third plurality is different from all of the angles of the first, second, and fourth plurality of angles; and

forming the production tool using the design.

88. (NEW) The production tool of claim 22, wherein the first geometric shape includes a base and first plurality of base edge lengths, wherein the second geometric shape includes a base and second plurality of base edge lengths, and wherein at least one of the base edge lengths of the first plurality is different from all of the base edge lengths of the second plurality of base edge lengths.

89. (NEW) The production tool of claim 23, wherein the first geometric shape includes a base and first plurality of base edge lengths, wherein the second geometric shape includes a base and second plurality of base edge lengths, wherein the third geometric shape includes a base and third

plurality of base edge lengths, wherein at least one of the base edge lengths of the first plurality is different from all of the base edge lengths of the second and third plurality of base edge lengths, and wherein at least one of the base edge lengths of the second plurality is different from all of the base edge lengths of the first and third plurality of base edge lengths.

90. (NEW) The production tool of claim 24, wherein the first geometric shape includes a base and first plurality of base edge lengths, wherein the second geometric shape includes a base and second plurality of base edge lengths, wherein the third geometric shape includes a base and third plurality of base edge lengths, wherein the fourth geometric shape includes a base and fourth plurality of base edge lengths, wherein at least one of the base edge lengths of the first plurality is different from all of the base edge lengths of the second, third, and fourth plurality of base edge lengths, wherein at least one of the base edge lengths of the second plurality is different from all of the base edge lengths of the first, third, and fourth plurality of base edge lengths, and wherein at least one of the base edge lengths of the third plurality is different from all of the base edge lengths of the first, second, and fourth plurality of base edge lengths.

91. (NEW) A production tool suitable for use in manufacturing an abrasive article comprising a first and second plurality of cavities, wherein the first plurality of cavities each have a first geometric shape including a base and first plurality of base edge lengths forming the base of the geometric shape and the second plurality of cavities each have a second geometric shape including a base and second plurality of base edge lengths forming the base of the geometric shape, wherein at least one of the base edge lengths of the first plurality is different from all of the base edge lengths of the second plurality of base edge lengths.

92. (NEW) A production tool suitable for use in manufacturing an abrasive article comprising a first, second, and third plurality of cavities, wherein the first plurality of cavities each have a first geometric shape including a base and first plurality of base edge lengths forming the base of the

geometric shape, the second plurality of cavities each have a second geometric shape including a base and second plurality of base edge lengths forming the base of the geometric shape, and the third plurality of cavities each have a third geometric shape including a base and third plurality of base edge lengths forming the base of the geometric shape, wherein at least one of the base edge lengths of the first plurality is different from all of the base edge lengths of the second and third plurality of base edge lengths, and wherein at least one of the base edge lengths of the second plurality is different from all of the base edge lengths of the first and third plurality of base edge lengths.

93. (NEW) A production tool suitable for use in manufacturing an abrasive article comprising a first, second, third, and fourth plurality of cavities, wherein the first plurality of cavities each have a first geometric shape including a base and first plurality of base edge lengths forming the base of the geometric shape, the second plurality of cavities each have a second geometric shape including a base and second plurality of base edge lengths forming the base of the geometric shape, the third plurality of cavities each have a third geometric shape including a base and third plurality of base edge lengths forming the base of the geometric shape, and the fourth plurality of cavities each have a fourth geometric shape including a base and fourth plurality of base edge lengths forming base of the geometric shape, wherein at least one of the base edge lengths of the first plurality is different from all of the base edge lengths of the second, third, and fourth plurality of base edge lengths, wherein at least one of the base edge lengths of the second plurality is different from all of the base edge lengths of the first, third, and fourth plurality of base edge lengths, and wherein at least of the base edge lengths one of the third plurality is different from all of the base edge lengths of the first, second, and fourth plurality of base edge lengths.

94. (NEW) A production tool suitable for use in manufacturing an abrasive article comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, the dimensions including base edge lengths, wherein at least 10% of pairs of adjacent cavities have at least one base edge length different between the two cavities of the pair.

95. (NEW) A production tool suitable for use in manufacturing an abrasive article comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, the dimensions including base edge lengths, wherein at least 30% of pairs of adjacent cavities have at least one base edge length different between the two cavities of the pair.

96. (NEW) A production tool suitable for use in manufacturing an abrasive article comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, the dimensions including base edge lengths, wherein at least 50% of pairs of adjacent cavities have at least one base edge length different between the two cavities of the pair.

97. (NEW) A production tool suitable for use in manufacturing an abrasive article comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, the dimensions including base edge lengths, and wherein at least two adjacent cavities have at least one base edge lengths different between the two cavities.

98. (NEW) The production tool of claim 91 which is a coating roll.

99. (NEW) The production tool of claim 92 which is a coating roll.

100. (NEW) The production tool of claim 93 which is a coating roll.

101. (NEW) The production tool of claim 94 which is a coating roll.

102. (NEW) The production tool of claim 95 which is a coating roll.

103. (NEW) The production tool of claim 96 which is a coating roll.

104. (NEW) The production tool of claim 97 which is a coating roll.
105. (NEW) The production tool of claim 91 which is an engraved metal roll.
106. (NEW) The production tool of claim 92 which is an engraved metal roll.
107. (NEW) The production tool of claim 93 which is an engraved metal roll.
108. (NEW) The production tool of claim 94 which is an engraved metal roll.
109. (NEW) The production tool of claim 95 which is an engraved metal roll.
110. (NEW) The production tool of claim 96 which is an engraved metal roll.
111. (NEW) The production tool of claim 97 which is an engraved metal roll.
112. (NEW) A method of making a production tool, the method comprising:
creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a first and second plurality of cavities, wherein the first plurality of cavities each have a first geometric shape including a base and first plurality of base edge lengths forming the base of the geometric shape and the second plurality of cavities each have a second geometric shape including a base and second plurality of base edge lengths forming the base of the geometric shape, wherein at least one of the base edge lengths of the first plurality is different from all of the base edge lengths of the second plurality of base edge lengths; and
forming the production tool using the design.

113. (NEW) A method of making a production tool, the method comprising:

creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a first, second, and third plurality of cavities, wherein the first plurality of cavities each have a first geometric shape including a base and first plurality of base edge lengths forming the base of the geometric shape, the second plurality of cavities each have a second geometric shape including a base and second plurality of base edge lengths forming the base of the geometric shape, and the third plurality of cavities each have a third geometric shape including a base and third plurality of base edge lengths forming the base of the geometric shape, wherein at least one of the base edge lengths of the first plurality is different from all of the base edge lengths of the second and third plurality of base edge lengths, and wherein at least one of the base edge lengths of the second plurality is different from all of the base edge lengths of the first and third plurality of base edge lengths; and

forming the production tool using the design.

114. (NEW) A method of making a production tool, the method comprising:

creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a first, second, third, and fourth plurality of cavities, wherein the first plurality of cavities each have a first geometric shape including a base and first plurality of base edge lengths forming the base of the geometric shape, the second plurality of cavities each have a second geometric shape including a base and second plurality of base edge lengths forming the base of the geometric shape, the third plurality of cavities each have a third geometric shape including a base and third plurality of base edge lengths forming the base of the geometric shape, and the fourth plurality of cavities each have a fourth geometric shape including a base and fourth plurality of base edge lengths forming the base of the geometric shape, wherein at least one of the base edge lengths of the first plurality is different from all of the base edge lengths of the second, third, and fourth plurality of base edge lengths, wherein at least one of the base edge lengths of the second plurality is different from all of the base edge lengths of the first, third, and fourth plurality of base edge lengths,

and wherein at least one of the base edge lengths of the third plurality is different from all of the base edge lengths of the first, second, and fourth plurality of base edge lengths; and
forming the production tool using the design.

115. (NEW) A method of making a production tool, the method comprising:

creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, the dimensions including base edge lengths wherein at least 10% of pairs of adjacent cavities have at least one base edge length different between the two cavities of the pair; and
forming the production tool using the design.

116. (NEW) A method of making a production tool, the method comprising:

creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, the dimensions including base edge lengths wherein at least 30% of pairs of adjacent cavities have at least one base edge length different between the two cavities of the pair; and
forming the production tool using the design.

117. (NEW) A method of making a production tool, the method comprising:

creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, the dimensions including base edge lengths wherein at least 50% of pairs of adjacent cavities have at least one base edge length different between the two cavities of the pair; and
forming the production tool using the design.

118. (NEW) A method of making a production tool, the method comprising:

creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, the dimensions including base edge lengths, and wherein at least two adjacent cavities have at least one base edge lengths different between the two cavities; and

forming the production tool using the design.

- 119. (NEW) The method of claim 112, wherein the production tool is a coating roll.
 - 120. (NEW) The method of claim 113, wherein the production tool is a coating roll.
 - 121. (NEW) The method of claim 114, wherein the production tool is a coating roll.
 - 122. (NEW) The method of claim 115, wherein the production tool is a coating roll.
 - 123. (NEW) The method of claim 116, wherein the production tool is a coating roll.
 - 124. (NEW) The method of claim 117, wherein the production tool is a coating roll.
 - 125. (NEW) The method of claim 118, wherein the production tool is a coating roll.
 - 126. (NEW) The method of claim 112, wherein the production tool is an engraving roll.
 - 127. (NEW) The method of claim 113, wherein the production tool is an engraving roll.
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- 128. (NEW) The method of claim 114, wherein the production tool is an engraving roll.

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- 129. (NEW) The method of claim 115, wherein the production tool is an engraving roll.
 - 130. (NEW) The method of claim 116, wherein the production tool is an engraving roll.
 - 131. (NEW) The method of claim 117, wherein the production tool is an engraving roll.
 - 132. (NEW) The method of claim 118, wherein the production tool is an engraving roll.
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REMARKS

Prior to taking up the above-identified patent application, the Examiner is asked to enter the above amendments to the claims. The pending claims are claims 1-132. Support for new claims 88-132 can be found throughout the specification, including the originally filed claims and drawings, as would be clearly understood by one of skill in the art. Examples of locations of support for these new claims are listed in the table below.

Claim 88, 91	Support can be found, e.g., at page 6, line 18 through page 7, line 15; at page 19, lines 14-20; at page 20, line 27 through page 21, line 2; at page 26, line 16 through page 27, line 7; and at page 10, lines 23-27.
Claim 89, 92	Support can be found, e.g., at page 6, line 18 through page 7, line 15; at page 10, line 23 through page 11, line 2; at page 19, lines 14-20; at page 26, line 16 through page 27, line 7; and at page 10, lines 23-27.
Claim 90, 93	Support can be found, e.g., at page 6, line 18 through page 7, line 15; at page 19, lines 14-20; at page 26, line 16 through page 27, line 7; and at page 10, lines 23-27.
Claim 94	Support can be found, e.g., at page 6, lines 18-25; at page 20, line 27 through page 21, line 18; at page 26, line 16 through page 27, line 7; and at page 10, lines 23-27.
Claim 95	Support can be found, e.g., at page 6, lines 18-25; at page 20, line 27 through page 21, line 18; at page 26, line 16 through page 27, line 7; and at page 10, lines 23-27.
Claim 96	Support can be found, e.g., at page 6, lines 18-25; at page 20, line 27 through page 21, line 18; at page 26, line 16 through page 27, line 7; and at page 10, lines 23-27.
Claim 97	Support can be found, e.g., at page 6, lines 18-25; at page 10, lines 5-10; at

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	page 11, lines 19-28; at page 21, lines 19-26; at page 26, line 16 through page 27, line 7; and at page 10, lines 23-27.
Claims 98-104	Support can be found, e.g., at page 28, lines 12-17; and above with respect to claims 91-97.
Claims 105-111	Support can be found, e.g., at page 28, lines 12-17; and above with respect to claims 91-97.
Claim 112	Support can be found, e.g., at page 6, line 18 through page 8, line 24; at page 19, lines 14-20; at page 20, line 27 through page 21, line 2; at page 26, line 16 through page 27, line 7; in originally filed claim 6; and at page 10, lines 23-27.
Claim 113	Support can be found, e.g., at page 6, line 18 through page 8, line 24; at page 10, line 23 through page 11, line 2; at page 19, lines 14-20; at page 26, line 16 through page 27, line 7; in originally filed claim 6; and at page 10, lines 23-27.
Claim 114	Support can be found, e.g., at page 6, line 18 through page 8, line 24; at page 19, lines 14-20; at page 26, line 16 through page 27, line 7; in originally filed claim 6; and at page 10, lines 23-27.
Claim 115	Support can be found, e.g., at page 6, lines 18-25; at page 7, line 16 through page 8, line 24; at page 20, line 27 through page 21, line 18; at page 26, line 16 through page 27, line 7; in originally filed claim 6; and at page 10, lines 23-27.
Claim 116	Support can be found, e.g., at page 6, lines 18-25; at page 7, line 16 through page 8, line 24; at page 20, line 27 through page 21, line 18; at page 26, line 16 through page 27, line 7; in originally filed claim 6; and at page 10, lines 23-27.

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Claim 117	Support can be found, e.g., at page 6, lines 18-25; at page 7, line 16 through page 8, line 24; at page 20, line 27 through page 21, line 18; at page 26, line 16 through page 27, line 7; in originally filed claim 6; and at page 10, lines 23-27.
Claim 118	Support can be found, e.g., at page 6, lines 18-25; at page 7, line 16 through page 8, line 24; at page 10, lines 5-10; at page 11, lines 19-28; at page 21, lines 19-26; and at page 26, line 16 through page 27, line 7; in originally filed claim 6; and at page 10, lines 23-27.
Claim 119-125	Support can be found, e.g., at page 28, lines 12-17; and above with respect to claims 112-118.
Claim 126-132	Support can be found, e.g., at page 28, lines 12-17; and above with respect to claims 112-118.

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CONCLUSION

It is respectfully submitted that the pending claims are in condition for allowance and notification to that effect is respectfully requested. The Examiner is invited to contact Applicants' Representatives, at the below-listed telephone number, if it is believed that prosecution of this application may be assisted thereby.

VIA FACSIMILE
TRANSMISSION ON
MAY 4, 2001.

Respectfully Submitted,

Timothy L. HOOPMAN et al.,

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**APPENDIX A - CLAIM AMENDMENTS INCLUDING NOTATIONS TO
INDICATE CHANGES MADE**

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For: TOOLS TO MANUFACTURE ABRASIVE ARTICLES

Docket No.: 49933 USA 6H

In The Claims

For convenience, all pending claims are shown below.

1. A master tool for manufacturing a production tool useful to manufacture an abrasive article that comprises a major surface having deployed in fixed position thereon first and second three-dimensional abrasive composites, each of said composites comprising abrasive particles dispersed in a binder and having a shape defined by a substantially distinct and discernible boundary which includes substantially specific dimensions, wherein said first abrasive composite has a first shape having specific first dimensions and said second abrasive composite has a second shape having second specific dimensions, wherein each of said abrasive composites has a boundary defined by at least four planar surfaces wherein adjacent planar surfaces of one composite meet at an edge to define an angle of intersection therebetween, wherein at least one angle of intersection of said first abrasive composite is different from all of the angles of intersection of said second composite, said master tool comprising a structure having a major surface having a plurality of adjacent three-dimensional shapes projecting therefrom, wherein each three-dimensional shape is defined by a substantially distinct and discernible boundary which includes substantially specific dimensions, wherein a first three-dimensional shape has a first shape having specific first dimensions and a second three-dimensional shape has a second shape having second specific dimensions, wherein each of said three-dimensional shapes has a boundary defined by at least four planar surfaces wherein adjacent planar surfaces of one three-dimensional shape meet at an edge to define an angle of intersection therebetween, wherein at least one angle of intersection of said first three-dimensional shape is different from all angles of intersection of said second three-dimensional shape.

2. The master tool of claim 1, wherein said three-dimensional shapes comprise pyramids.
 3. The master tool of claim 2, wherein each said pyramid comprises planar surfaces which intersect to form a material-included angle at a distal end of said pyramid, wherein said material-included angle is a value from 25° and 90°.
 4. The master tool of claim 1, comprised of a metal material.
 5. The master tool of claim 4, wherein said master tool surface is nickel-plated.
 6. A master tool for manufacturing a production tool useful to shape an abrasive slurry into an array of three-dimensional nonidentical abrasive composites, said master tool having a major surface extending within a first imaginary plane, said master tool being made by a method comprising the steps of:
 - (1) determining angles corresponding to facing right and left planar surfaces of adjacent three-dimensional shapes and wherein each of said angles has a value as measured between its planar surface and a plane which extends in a normal direction to said major surface and contains an edge of said planar surface in contact with said major surface, by the following substeps:
 - (i) selecting an angle value between, but not including, 0° and 90° to establish a first right half angle of a first right planar surface of a first right-side three-dimensional shape with a random number generating means capable of randomly selecting an angle value between, but not including, 0° and 90°;
 - (ii) selecting an angle value between, but not including, 0° and 90° with said random number generating means to establish a first left half angle for a first left planar surface of a first left-side three-dimensional shape facing said first right planar surface of said first right-side three-dimensional shape;
-

(iii) proceeding along a first direction extending linearly within said first imaginary plane to a second left planar surface of a second left-side three-dimensional shape located adjacent said first left-side three-dimensional shape and using said random number generating means to select a value between, but not including, 0° and 90° to establish a second left planar angle for said second left planar surface;

(iv) using said random number generating means to select a value between, but not including, 0° and 90° for a second right planar surface of a second right-side three-dimensional shape facing said second left planar surface;

(v) proceeding along said first direction to a third right-side three-dimensional shape located adjacent said second right-side three-dimensional shape;

(vi) repeating said substeps (i), (ii), (iii), (iv), and (v), in that sequence, at least once;

(2) repeating step (1) except that the angles are determined for left and right planar surfaces of adjacent three-dimensional shapes deployed in two adjacent rows in a second direction extending linearly within said first imaginary plane, wherein said first and second directions intersect;

(3) using means to determine, for a given width of said surface of said master, locations of grooves required to be cut by a cutting means to form a series of intersecting grooves defining a plurality of three-dimensional shapes having said angles calculated by steps (1) and (2); and

(4) providing a cutting means to cut grooves in said surface of said master in correspondence to said angles calculated by steps (1) and (2) and said groove locations determined by step (3) to form a series of intersecting grooves which define a plurality of three-dimensional shapes upraised from said surface, each of said shapes being defined by a distinct and discernible boundary including specific dimensions, wherein not all said three-dimensional shapes are identical.

7. The master tool of claim 6, wherein said right and left half angles each have a value between 8° and 45° .

8. The master tool of claim 6, wherein said three-dimensional shapes comprise pyramids.
9. The master tool of claim 6, wherein each said pyramid comprises planar surfaces which intersect to form a material-included angle at a distal end of said pyramid, wherein said material-included angle is a value from 25° and 90°.
10. The master tool of claim 6, wherein said cutting means comprises a diamond cutting tool.
11. The master tool of claim 6, comprised of a metal material.
12. The master tool of claim 6 wherein said major surface is nickel-plated after completing said step (4).
13. The master tool of claim 6, wherein said first and said second directions are oriented perpendicular to each other.
14. A production tool for manufacturing an abrasive article that comprises a major surface having deployed in fixed position thereon first and second three-dimensional abrasive composites, each of said composites comprising abrasive particles dispersed in a binder and having a shape defined by a substantially distinct and discernible boundary which includes substantially specific dimensions, wherein said first abrasive composite has a shape having specific first dimensions and said second abrasive composite has a second shape having second specific dimensions, wherein each of said abrasive composites has a boundary defined by at least four planar surfaces wherein adjacent planar surfaces of one composite meet at an edge to define an angle of intersection therebetween, wherein at least one angle of intersection of said first abrasive composite is different from all of the angles of intersection of said second composite, said production

tool comprising a structure having a plurality of adjacent three-dimensional cavities form on a major surface thereof, wherein each three-dimensional cavity is defined by a substantially distinct and discernible boundary which includes substantially specific dimensions, wherein a first three-dimensional cavity has a first shape having specific first dimensions and a second three-dimensional cavity has a second shape having second specific dimensions, wherein each of said three-dimensional cavities has a boundary defined by at least four planar surfaces wherein adjacent planar surfaces of one three-dimensional cavity meet at an edge to define an angle of intersection therebetween, wherein at least one angle of intersection of said first three-dimensional cavity is different from all angles of intersection of said second three-dimensional cavity.

15. The production tool of claim 14, wherein said three-dimensional cavities comprise geometrical shapes.

16. The production tool of claim 14, wherein said geometrical shapes are selected from the group of geometrical shapes consisting of cubic, prismatic, pyramidal and truncated pyramidal shapes.

17. The production tool of claim 16, wherein each said pyramidal shape comprises planar surfaces which intersect to form a material-included angle at a distal end of said pyramid, wherein said material-included angle is a value from 25° and 90°.

18. The production tool of claim 14, comprised of a material selected from the group consisting of metal, metal alloy and plastic.

19. A production tool useful to shape an abrasive slurry into an array of three-dimensional nonidentical abrasive composites, said production tool manufactured from a master tool, said master tool being made by a method comprising the steps of:

(1) determining angles corresponding to facing right and left planar surfaces of adjacent three-dimensional shapes and wherein each of said angles has a value as measured between its planar surface and a plane which extends in a normal direction to said major surface and contains an edge of said planar surface in contact with said major surface, by the following substeps:

(i) selecting an angle value between, but not including, 0° and 90° to establish a first right half angle of a first right planar surface of a first right-side three-dimensional shape with a random number generating means capable of randomly selecting an angle value between, but not including, 0° and 90° ;

(ii) selecting an angle value between, but not including, 0° and 90° with said random number generating means to establish a first left half angle for a first left planar surface of a first left-side three-dimensional shape facing said first right planar surface of said first right-side three-dimensional shape;

(iii) proceeding along a first direction extending linearly within said first imaginary plane to a second left planar surface of a second left-side three-dimensional shape located adjacent said first left-side three-dimensional shape and using said random number generating means to select a value between, but not including, 0° and 90° to establish a second left planar angle for said second left planar surface;

(iv) using said random number generating means to select a value between, but not including, 0° and 90° for a second right planar surface of a second right-side three-dimensional shape facing said second left planar surface;

(v) proceeding along said first direction to a third right-side three-dimensional shape located adjacent said second right-side three-dimensional shape;

(vi) repeating said substeps (i), (ii), (iii), (iv), and (v), in that sequence, at least once;

(2) repeating step (1) except that the angles are determined for left and right planar surfaces of adjacent three-dimensional shapes deployed in two adjacent rows in a second direction extending linearly within said first imaginary plane, wherein said first and second directions intersect;

(3) using means to determine, for a given width of said surface of said master, locations of grooves required to be cut by a cutting means to form a series of intersecting grooves defining a plurality of three-dimensional shapes having said angles calculated by steps (1) and (2); and

(4) providing a cutting means to cut grooves in said surface of said master in correspondence to said angles calculated by steps (1) and (2) and said groove locations determined by step (3) to form a series of intersecting grooves which define a plurality of three-dimensional shapes upraised from said surface, each of said shapes being defined by a distinct and discernible boundary including specific dimensions, wherein not all said three-dimensional shapes are identical.

20. The production tool of claim 14 comprising a roll.

21. The production tool of claim 20 comprising a coating roll.

22. A production tool suitable for use in manufacturing an abrasive article comprising a first and second plurality of cavities, wherein the first plurality of cavities each have a first geometric shape and first plurality of angles forming the geometric shape and the second plurality of cavities each have a second geometric shape and second plurality of angles forming the geometric shape, wherein at least one of the angles of the first plurality is different from all of the angles of the second plurality of angles.

23. (AMENDED) A production tool suitable for use in manufacturing an abrasive article comprising a first, second, and third plurality of cavities, wherein the first plurality of cavities each have a first geometric shape and first plurality of angles forming the geometric shape, the second plurality of cavities each have a second geometric shape and second plurality of angles forming the geometric shape, and the third plurality of cavities each have a third geometric shape and third plurality of angles forming the geometric shape, wherein at least one of the angles of the first plurality is different from all of the angles of the second

and third plurality of angles, and wherein at least one of the angles of the second plurality is different from all of the angles of the first and third plurality of angles.

24. (AMENDED) A production tool suitable for use in manufacturing an abrasive article comprising a first, second, third, and fourth plurality of cavities, wherein the first plurality of cavities each have a first geometric shape and first plurality of angles forming the geometric shape, the second plurality of cavities each have a second geometric shape and second plurality of angles forming the geometric shape, the third plurality of cavities each have a third geometric shape and third plurality of angles forming the geometric shape, and the fourth plurality of cavities each have a fourth geometric shape and fourth plurality of angles forming the geometric shape, wherein at least one of the angles of the first plurality is different from all of the angles of the second, third, and fourth plurality of angles, wherein at least one of the angles of the second plurality is different from all of the angles of the first, third, and fourth plurality of angles, and wherein at least one of the angles of the third plurality is different from all of the angles of the first, second, and fourth plurality of angles.

25. A production tool suitable for use in manufacturing an abrasive article comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, wherein at least 10% of pairs of adjacent cavities have at least one dimension different between the two cavities of the pair.

26. A production tool suitable for use in manufacturing an abrasive article comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, wherein at least 30% of pairs of adjacent cavities have at least one dimension different between the two cavities of the pair.

27. A production tool suitable for use in manufacturing an abrasive article comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, wherein at least 50% of pairs of adjacent cavities have at least one dimension different between the two cavities of the pair.

28. A production tool suitable for use in manufacturing an abrasive article comprising a plurality of cavities, wherein the cavities each have a geometric shape, dimensions defining the cavity, and angles forming the geometric shape, wherein the angles are different in at least two of the cavities, and further wherein at least 10% of pairs of adjacent cavities have at least one dimension different between the two cavities of the pair.

29. A production tool suitable for use in manufacturing an abrasive article comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, and wherein at least two adjacent cavities have at least one dimension different between the two cavities.

30. A production tool suitable for use in manufacturing an abrasive article comprising a plurality of cavities defining at least a first and a second group, wherein a first group of cavities has a first shape and a second group of cavities has a second, different, shape.

31. A production tool suitable for use in manufacturing an abrasive article comprising a plurality of cavities defining at least a first and a second group, wherein a first group of cavities has a first size and a second group of cavities has a second, different, size.

32. A production tool suitable for use in manufacturing an abrasive article comprising a plurality of cavities defined by substantially distinct and discernible boundaries which include substantially specific dimensions, wherein a first cavity has specific first dimensions and a second cavity has specific second dimensions, and further wherein each of said cavities has a boundary defined by at least four planar surfaces wherein adjacent planar surfaces of one cavity meet at an edge to define an angle of intersection therebetween, wherein at least one angle of intersection of said first cavity is different from all the angles of intersection of said second cavity.

33. The production tool of claim 22 which is a coating roll.

34. The production tool of claim 23 which is a coating roll.
 35. The production tool of claim 24 which is a coating roll.
 36. The production tool of claim 25 which is a coating roll.
 37. The production tool of claim 26 which is a coating roll.
 38. The production tool of claim 27 which is a coating roll.
 39. The production tool of claim 28 which is a coating roll.
 40. The production tool of claim 29 which is a coating roll.
 41. The production tool of claim 30 which is a coating roll.
 42. The production tool of claim 31 which is a coating roll.
 43. The production tool of claim 32 which is a coating roll.
 44. The production tool of claim 22 which is an engraved metal roll.
 45. The production tool of claim 23 which is an engraved metal roll.
 46. The production tool of claim 24 which is an engraved metal roll.
 47. The production tool of claim 25 which is an engraved metal roll.
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48. The production tool of claim 26 which is an engraved metal roll.

49. The production tool of claim 27 which is an engraved metal roll.
50. The production tool of claim 28 which is an engraved metal roll.
51. The production tool of claim 29 which is an engraved metal roll.
52. The production tool of claim 30 which is an engraved metal roll.
53. The production tool of claim 31 which is an engraved metal roll.
54. The production tool of claim 32 which is an engraved metal roll.
55. A method of making a production tool, the method comprising:
creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a first and second plurality of cavities, wherein the first plurality of cavities each have a first geometric shape and first plurality of angles forming the geometric shape and the second plurality of cavities each have a second geometric shape and second plurality of angles forming the geometric shape, wherein at least one of the angles of the first plurality is different from all of the angles of the second plurality of angles; and
forming the production tool using the design.
56. (AMENDED) A method of making a production tool, the method comprising:
creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a first, second, and third plurality of cavities, wherein the first plurality of cavities each have a first geometric shape and first plurality of angles forming the geometric shape, the second plurality of cavities each have a second geometric shape and second plurality of angles forming the geometric shape, and the third plurality of cavities each have a third geometric shape and third plurality of angles forming the geometric shape, wherein at least one of the angles of the first plurality is different from all of the angles of the second

and third plurality of angles, and wherein at least one of the angles of the second plurality is different from all of the angles of the first and third plurality of angles; and
forming the production tool using the design.

57. (AMENDED) A method of making a production tool, the method comprising:
creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a first, second, third, and fourth plurality of cavities, wherein the first plurality of cavities each have a first geometric shape and first plurality of angles forming the geometric shape, the second plurality of cavities each have a second geometric shape and second plurality of angles forming the geometric shape, the third plurality of cavities each have a third geometric shape and third plurality of angles forming the geometric shape, and the fourth plurality of cavities each have a fourth geometric shape and fourth plurality of angles forming the geometric shape, wherein at least one of the angles of the first plurality is different from all of the angles of the second, third, and fourth plurality of angles, wherein at least one of the angles of the second plurality is different from all of the angles of the first, third, and fourth plurality of angles, and wherein at least one of the angles of the third plurality is different from all of the angles of the first, second, and fourth plurality of angles; and
forming the production tool using the design.

58. A method of making a production tool, the method comprising:
creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, wherein at least 10% of pairs of adjacent cavities have at least one dimension different between the two cavities of the pair; and
forming the production tool using the design.

59. A method of making a production tool, the method comprising:
creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a plurality of cavities, wherein the cavities each have dimensions defining

the cavity, wherein at least 30% of pairs of adjacent cavities have at least one dimension different between the two cavities of the pair; and
forming the production tool using the design.

60. A method of making a production tool, the method comprising:
creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, wherein at least 50% of pairs of adjacent cavities have at least one dimension different between the two cavities of the pair; and
forming the production tool using the design.

61. A method of making a production tool, the method comprising:
creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a plurality of cavities, wherein the cavities each have a geometric shape, dimensions defining the cavity, and angles forming the geometric shape, wherein the angles are different in at least two of the cavities, and further wherein at least 10% of pairs of adjacent cavities have at least one dimension different between the two cavities of the pair;
and
forming the production tool using the design.

62. A method of making a production tool, the method comprising:
creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, and wherein at least two adjacent cavities have at least one dimension different between the two cavities; and
forming the production tool using the design.

63. A method of making a production tool, the method comprising:
creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a plurality of cavities defining at least a first and a second group, wherein a

first group of cavities has a first shape and a second group of cavities has a second, different, shape; and

forming the production tool using the design.

64. A method of making a production tool, the method comprising:
creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a plurality of cavities defining at least a first and a second group, wherein a first group of cavities has a first size and a second group of cavities has a second, different, size; and

forming the production tool using the design.

65. A method of making a production tool, the method comprising:
creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a plurality of cavities defined by substantially distinct and discernible boundaries which include substantially specific dimensions, wherein a first cavity has specific first dimensions and a second cavity has specific second dimensions, and further wherein each of said cavities has a boundary defined by at least four planar surfaces wherein adjacent planar surfaces of one cavity meet at an edge to define an angle of intersection therebetween, wherein at least one angle of intersection of said first cavity is different from all the angles of intersection of said second cavity; and

forming the production tool using the design.

66. The method of claim 55, wherein the production tool is a coating roll.

67. The method of claim 56, wherein the production tool is a coating roll.

68. The method of claim 57, wherein the production tool is a coating roll.

69. The method of claim 58, wherein the production tool is a coating roll.

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70. The method of claim 59, wherein the production tool is a coating roll.
 71. The method of claim 60, wherein the production tool is a coating roll.
 72. The method of claim 61, wherein the production tool is a coating roll.
 73. The method of claim 62, wherein the production tool is a coating roll.
 74. The method of claim 63, wherein the production tool is a coating roll.
 75. The method of claim 64, wherein the production tool is a coating roll.
 76. The method of claim 65, wherein the production tool is a coating roll.
 77. The method of claim 55, wherein the production tool is an engraving roll.
 78. The method of claim 56, wherein the production tool is an engraving roll.
 79. The method of claim 57, wherein the production tool is an engraving roll.
 80. The method of claim 58, wherein the production tool is an engraving roll.
 81. The method of claim 59, wherein the production tool is an engraving roll.
 82. The method of claim 60, wherein the production tool is an engraving roll.
 83. The method of claim 61, wherein the production tool is an engraving roll.
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84. The method of claim 62, wherein the production tool is an engraving roll.

85. The method of claim 63, wherein the production tool is an engraving roll.

86. The method of claim 64, wherein the production tool is an engraving roll.

87. The method of claim 65, wherein the production tool is an engraving roll.

88. (NEW) The production tool of claim 22, wherein the first geometric shape includes a base and first plurality of base edge lengths, wherein the second geometric shape includes a base and second plurality of base edge lengths, and wherein at least one of the base edge lengths of the first plurality is different from all of the base edge lengths of the second plurality of base edge lengths.

89. (NEW) The production tool of claim 23, wherein the first geometric shape includes a base and first plurality of base edge lengths, wherein the second geometric shape includes a base and second plurality of base edge lengths, wherein the third geometric shape includes a base and third plurality of base edge lengths, wherein at least one of the base edge lengths of the first plurality is different from all of the base edge lengths of the second and third plurality of base edge lengths, and wherein at least one of the base edge lengths of the second plurality is different from all of the base edge lengths of the first and third plurality of base edge lengths.

90. (NEW) The production tool of claim 24, wherein the first geometric shape includes a base and first plurality of base edge lengths, wherein the second geometric shape includes a base and second plurality of base edge lengths, wherein the third geometric shape includes a base and third plurality of base edge lengths, wherein the fourth geometric shape includes a base and fourth plurality of base edge lengths, wherein at least one of the base edge lengths of the first plurality is different from all of the base edge lengths of the second, third, and fourth plurality of base edge lengths, wherein at least one of the base edge lengths of the second plurality is different from all of the base edge lengths of the first, third, and fourth

plurality of base edge lengths, and wherein at least of the base edge lengths one of the third plurality is different from all of the base edge lengths of the first, second, and fourth plurality of base edge lengths.

91. (NEW) A production tool suitable for use in manufacturing an abrasive article comprising a first and second plurality of cavities, wherein the first plurality of cavities each have a first geometric shape including a base and first plurality of base edge lengths forming the base of the geometric shape and the second plurality of cavities each have a second geometric shape including a base and second plurality of base edge lengths forming the base of the geometric shape, wherein at least one of the base edge lengths of the first plurality is different from all of the base edge lengths of the second plurality of base edge lengths.

92. (NEW) A production tool suitable for use in manufacturing an abrasive article comprising a first, second, and third plurality of cavities, wherein the first plurality of cavities each have a first geometric shape including a base and first plurality of base edge lengths forming the base of the geometric shape, the second plurality of cavities each have a second geometric shape including a base and second plurality of base edge lengths forming the base of the geometric shape, and the third plurality of cavities each have a third geometric shape including a base and third plurality of base edge lengths forming the base of the geometric shape, wherein at least one of the base edge lengths of the first plurality is different from all of the base edge lengths of the second and third plurality of base edge lengths, and wherein at least one of the base edge lengths of the second plurality is different from all of the base edge lengths of the first and third plurality of base edge lengths.

93. (NEW) A production tool suitable for use in manufacturing an abrasive article comprising a first, second, third, and fourth plurality of cavities, wherein the first plurality of cavities each have a first geometric shape including a base and first plurality of base edge lengths forming the base of the geometric shape, the second plurality of cavities each have a second geometric shape including a base and second plurality of base edge lengths forming the base of the geometric shape, the third plurality of cavities each have a third geometric

shape including a base and third plurality of base edge lengths forming the base of the geometric shape, and the fourth plurality of cavities each have a fourth geometric shape including a base and fourth plurality of base edge lengths forming base of the geometric shape, wherein at least one of the base edge lengths of the first plurality is different from all of the base edge lengths of the second, third, and fourth plurality of base edge lengths, wherein at least one of the base edge lengths of the second plurality is different from all of the base edge lengths of the first, third, and fourth plurality of base edge lengths, and wherein at least of the base edge lengths one of the third plurality is different from all of the base edge lengths of the first, second, and fourth plurality of base edge lengths.

94. (NEW) A production tool suitable for use in manufacturing an abrasive article comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, the dimensions including base edge lengths, wherein at least 10% of pairs of adjacent cavities have at least one base edge length different between the two cavities of the pair.

95. (NEW) A production tool suitable for use in manufacturing an abrasive article comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, the dimensions including base edge lengths, wherein at least 30% of pairs of adjacent cavities have at least one base edge length different between the two cavities of the pair.

96. (NEW) A production tool suitable for use in manufacturing an abrasive article comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, the dimensions including base edge lengths, wherein at least 50% of pairs of adjacent cavities have at least one base edge length different between the two cavities of the pair.

97. (NEW) A production tool suitable for use in manufacturing an abrasive article comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, the dimensions including base edge lengths, and wherein at least two adjacent cavities have at least one base edge lengths different between the two cavities.

98. (NEW) The production tool of claim 91 which is a coating roll.

99. (NEW) The production tool of claim 92 which is a coating roll.

100. (NEW) The production tool of claim 93 which is a coating roll.

101. (NEW) The production tool of claim 94 which is a coating roll.

102. (NEW) The production tool of claim 95 which is a coating roll.

103. (NEW) The production tool of claim 96 which is a coating roll.

104. (NEW) The production tool of claim 97 which is a coating roll.

105. (NEW) The production tool of claim 91 which is an engraved metal roll.

106. (NEW) The production tool of claim 92 which is an engraved metal roll.

107. (NEW) The production tool of claim 93 which is an engraved metal roll.

108. (NEW) The production tool of claim 94 which is an engraved metal roll.

109. (NEW) The production tool of claim 95 which is an engraved metal roll.

110. (NEW) The production tool of claim 96 which is an engraved metal roll.

111. (NEW) The production tool of claim 97 which is an engraved metal roll.

112. (NEW) A method of making a production tool, the method comprising:

creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a first and second plurality of cavities, wherein the first plurality of cavities each have a first geometric shape including a base and first plurality of base edge lengths forming the base of the geometric shape and the second plurality of cavities each have a second geometric shape including a base and second plurality of base edge lengths forming the base of the geometric shape, wherein at least one of the base edge lengths of the first plurality is different from all of the base edge lengths of the second plurality of base edge lengths; and

forming the production tool using the design.

113. (NEW) A method of making a production tool, the method comprising:

creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a first, second, and third plurality of cavities, wherein the first plurality of cavities each have a first geometric shape including a base and first plurality of base edge lengths forming the base of the geometric shape, the second plurality of cavities each have a second geometric shape including a base and second plurality of base edge lengths forming the base of the geometric shape, and the third plurality of cavities each have a third geometric shape including a base and third plurality of base edge lengths forming the base of the geometric shape, wherein at least one of the base edge lengths of the first plurality is different from all of the base edge lengths of the second and third plurality of base edge lengths, and wherein at least one of the base edge lengths of the second plurality is different from all of the base edge lengths of the first and third plurality of base edge lengths; and

forming the production tool using the design.

114. (NEW) A method of making a production tool, the method comprising:

creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a first, second, third, and fourth plurality of cavities, wherein the first plurality of cavities each have a first geometric shape including a base and first plurality of base edge lengths forming the base of the geometric shape, the second plurality of cavities each have a second geometric shape including a base and second plurality of base edge

lengths forming the base of the geometric shape, the third plurality of cavities each have a third geometric shape including a base and third plurality of base edge lengths forming the base of the geometric shape, and the fourth plurality of cavities each have a fourth geometric shape including a base and fourth plurality of base edge lengths forming the base of the geometric shape, wherein at least one of the base edge lengths of the first plurality is different from all of the base edge lengths of the second, third, and fourth plurality of base edge lengths, wherein at least one of the base edge lengths of the second plurality is different from all of the base edge lengths of the first, third, and fourth plurality of base edge lengths, and wherein at least one of the base edge lengths of the third plurality is different from all of the base edge lengths of the first, second, and fourth plurality of base edge lengths; and forming the production tool using the design.

115. (NEW) A method of making a production tool, the method comprising:

creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, the dimensions including base edge lengths wherein at least 10% of pairs of adjacent cavities have at least one base edge length different between the two cavities of the pair; and

forming the production tool using the design.

116. (NEW) A method of making a production tool, the method comprising:

creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, the dimensions including base edge lengths wherein at least 30% of pairs of adjacent cavities have at least one base edge length different between the two cavities of the pair; and

forming the production tool using the design.

117. (NEW) A method of making a production tool, the method comprising:

creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, the dimensions including base edge lengths wherein at least 50% of pairs of adjacent cavities have at least one base edge length different between the two cavities of the pair; and

forming the production tool using the design.

118. (NEW) A method of making a production tool, the method comprising:

creating a design for a production tool for manufacturing an abrasive article, the production tool comprising a plurality of cavities, wherein the cavities each have dimensions defining the cavity, the dimensions including base edge lengths, and wherein at least two adjacent cavities have at least one base edge lengths different between the two cavities; and
forming the production tool using the design.

119. (NEW) The method of claim 112, wherein the production tool is a coating roll.

120. (NEW) The method of claim 113, wherein the production tool is a coating roll.

121. (NEW) The method of claim 114, wherein the production tool is a coating roll.

122. (NEW) The method of claim 115, wherein the production tool is a coating roll.

123. (NEW) The method of claim 116, wherein the production tool is a coating roll.

124. (NEW) The method of claim 117, wherein the production tool is a coating roll.

125. (NEW) The method of claim 118, wherein the production tool is a coating roll.

126. (NEW) The method of claim 112, wherein the production tool is an engraving roll.

127. (NEW) The method of claim 113, wherein the production tool is an engraving roll.

128. (NEW) The method of claim 114, wherein the production tool is an engraving roll.

129. (NEW) The method of claim 115, wherein the production tool is an engraving roll.

130. (NEW) The method of claim 116, wherein the production tool is an engraving roll.

131. (NEW) The method of claim 117, wherein the production tool is an engraving roll.

132. (NEW) The method of claim 118, wherein the production tool is an engraving roll.
